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EFFECT OF NEW JERSEY-NEW YORK POUND-NET CATCHES ON SHAD RUNS OF HUDSON AND CONNECTICUT RIVERS

BY PAUL R. NICHOLS

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ABSTRACT

A shad-tagging study conducted off the New Jersey-New York coasts during the spring of 1956 indicated that the New Jersey-New York ocean pound-net shad catch was composed of 76 percent Hudson River shad and 13 percent Connecticut River shad. Since the majority of shad caught off the coasts of New Jersey and New York are native to the Hudson and Connecticut Rivers, large ocean catches in any one year could affect the size of runs available to these rivers. The New Jersey-New York coastal shad catch has no effect on the deviations that occur between calculated and predicted size of Hudson River and Connecticut River shad runs. It was found that the New Jersey-New York pound-net shad catch is dependent on the size of the Hudson River shad population.

EFFECT OF NEW JERSEY–NEW YORK POUND-NET CATCHES ON SHAD RUNS OF HUDSON AND CONNECTICUT RIVERS

By PAUL R. NICHOLS, *Fishery Research Biologist*
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From the early years of this century until 1950, the Atlantic coast commercial catch of American shad (*Alosa sapidissima*) declined from approximately 50 million pounds to 8 million pounds. As part of an investigation sponsored by the Atlantic States Marine Fisheries Commission to determine the causes for the decline in abundance of shad, the United States Fish and Wildlife Service conducted studies on the Hudson River (Talbot 1954) and Connecticut River (Fredin 1954) shad fisheries 1950 and 1951. These studies showed that, within the limits of the populations studied, the largest single factor influencing fluctuations in abundance in both rivers was the number of shad escaping the commercial fishery to spawn. Regression formulas were presented by which the size of each population could be predicted 1 year in advance. Deviations between predicted and actual population size were also given.

One factor which could affect the magnitude of these deviations is mortality (fishing and natural) occurring outside of the rivers. The studies on the Hudson and Connecticut Rivers and limited experiments by E. H. Hollis,[1] indicate that Hudson and Connecticut River shad are taken outside these rivers along the Atlantic coast from North Carolina to Maine, particularly along the coast of New Jersey and off Staten Island, N. Y. If the major part of the shad catch from the New Jersey–Staten Island coast is composed of shad native to the Hudson and Connecticut Rivers, then a large ocean catch in this area in any one year could possibly affect the size of the runs available to these rivers. The present study was conducted to determine the effect of the New Jersey–New York pound-net catch on the shad runs of the Hudson and Connecticut Rivers.

[1] Unpublished report, U. S. Fishery Laboratory, Beaufort, N. C.

NOTE.—Approved for publication, December 6, 1957. Fishery Bulletin 143.

An expression of appreciation is due the members of the staff of the U. S. Fishery Laboratory, Beaufort, N. C., who helped in the field work and reviewed this paper. The aid of the shad fishermen of the middle and north Atlantic areas is gratefully acknowledged. Without their cooperation and return of tags this study could not have been completed.

LIFE HISTORY

The shad, largest member of the herring family in the United States, is anadromous. It spends most of its life in the sea but ascends coastal rivers to spawn. Shad enter the rivers of the Atlantic coast progressively later from south to north, commencing as early as November in Florida and as late as May and June in Canadian rivers. Shad are prolific spawners, as shown by Lehman (1953). The annual fecundity of 22 female shad collected in the Hudson River in 1951 was found to range from 116,000 to 468,000 ova, and was directly proportional to the length, weight, and age of the fish. According to Leim (1924), the eggs hatch in 12 to 15 days at 52° F. (12° C.), in 6 to 8 days at 63° F. (17° C.), and the larvae are about 9 to 10 mm. long at the time of hatching. The larvae develop into their final form in 4 to 5 days at a water temperature of 63° F. The young shad remain in the rivers until fall when they migrate to sea. Upon reaching sexual maturity in 3 to 5 years they return to fresh water to spawn, and it is during this migration that shad are taken by fishermen.

NEW JERSEY-NEW YORK OCEAN POUND-NET SHAD FISHERY

Since 1896, the first year for which detailed information is available, pound nets have been the principal type of commercial gear used in taking shad along the New Jersey and New York

coasts. Fyke nets, floating traps, haul seines, gill nets, and weirs have accounted for small catches, but their take is relatively unimportant compared to the pound-net landings. Pound nets are operated along the New Jersey coast from Cape May to Raritan Bay and in New York from Staten Island to the eastern tip of Long Island. The majority of shad are taken between Beach Haven, N. J., and Staten Island, N. Y. Relatively large catches of shad were taken off Long Island between the years 1939 and 1946, but since 1946 catches in this area have been negligible.

Each year shad appear in large numbers along the New Jersey–Staten Island coast during the months of March, April, and May; however, the largest catches are usually made during April. Table 1 shows the pound-net catch of shad and number of pound nets fished in New Jersey and New York for most years from 1921 through 1956. From 1921 through 1926, the operating units of gear included floating trap nets and weirs which accounted for some of the landings; however, these gears took less than 5 percent of the total catch. In recent years the number of pound nets fished in these areas has decreased. In 1931, 632 pound nets were licensed in the States of New Jersey and New York, but by 1954 only 220 were licensed.

TABLE 1.—*Pound-net shad catch and number of pound nets licensed in New Jersey and New York, 1921–56*

[Statistics for 1921–38, from U. S. Bureau of Fisheries; for 1939–54, from U. S. Fish and Wildlife Service; for 1955–56, from preliminary data of U. S. Fish and Wildlife Service]

Year	Catch (in pounds)			Units of gear		
	New Jersey	New York	Total	New Jersey	New York	Total
1921	36,423	7,052	43,475	217	414	631
1926	63,830	10,059	73,889	198	422	620
1929	19,780	1,446	21,226	181	445	626
1931	56,228	13,060	69,288	186	446	632
1932	54,231	2,988	57,219	163	308	471
1933	63,109	15,758	78,867	153	301	454
1935	251,200	21,900	273,100	156	295	451
1937	1,145,600	38,700	1,184,300	191	136	327
1938	602,200	98,800	701,000	175	125	300
1939	445,100	145,100	590,200	194	106	300
1940	1,199,800	84,400	1,284,200	193	132	325
1942	2,605,400	258,900	2,864,300	171	74	245
1943	1,200,000	565,000	1,765,000	125	67	192
1944	1,838,200	446,100	2,284,300	129	60	189
1945	1,249,900	758,200	2,008,100	113	74	187
1946	[1] 499,877	296,500	796,377	[2]	103	------
1947	337,700	291,100	628,800	127	141	268
1948	467,500	267,500	735,000	122	161	283
1949	300,700	139,200	439,900	77	153	230
1950	267,900	213,600	481,500	76	138	214
1951	156,500	48,400	204,900	88	144	232
1952	561,600	282,600	844,200	138	117	255
1953	78,400	25,500	103,900	110	94	204
1954	130,100	121,600	251,700	89	131	220
1955	288,800	111,554	400,354	51	[3]	------
1956	228,544	122,685	351,229	48	[3]	------

[1] From New Jersey Department of Fish and Game.
[2] Units of gear not determined.
[3] Not available.

Analysis of the catch data in table 1 shows that the New Jersey–New York pound-net shad catch was low from 1921 through 1933, followed by a tremendous increase from 1937 through 1945. From 1946 through 1956 the commercial catch again decreased and is now at a moderately low level. Part of this decrease in catch in recent years can probably be attributed to a decline in the amount of gear fished.

TAGGING STUDY, 1956

During the spring of 1956, shad were tagged from pound nets located off the coasts of New Jersey and Staten Island, N. Y., to determine the composition or population origin of the fish taken in these waters. Beach Haven, the southernmost point on the New Jersey coast where pound nets are fished for shad, was selected as the southern tagging site. Staten Island, where the largest pound-net catches of shad are taken, was selected as the northern tagging site. Point Pleasant, N. J., located about midway between Beach Haven and Staten Island, was selected as the third tagging location.

Shad were brailed from the pound net and held in washtubs on the fantail of the pound boat. Individual shad were removed from the tub, placed in a tagging cradle, tagged, and released. Fish were tagged with Petersen disk tags, consisting of two red plastic disks fastened directly under the dorsal fin by means of a nickel pin. Observations at the time the fish were returned to the ocean indicated that the shad suffered no apparent ill effects from the handling or tagging and that mortality from the tagging operation was probably small.

Shad were tagged throughout the shad fishing season from March 28 through May 23, so that as near as possible the entire run was proportionally sampled. During this period a total of 2,959 shad were tagged: 943 at Beach Haven, 962 at Point Pleasant, and 1,054 off Staten Island.

After the tagged fish were released, the success of the tagging study was largely dependent upon return of tags by commercial fishermen. About 1 week prior to the fishing season, biologists interviewed all commercial shad fishermen who fished the Hudson and Connecticut Rivers and off the New Jersey and New York coasts, and explained the tagging program. During the fishing season

Each commercial fisherman was contacted weekly to pick up tags they had recovered and to pay them the 50-cent reward for each tag returned.

Recoveries from areas outside of the present study area were dependent on return of the tags by mail. Fortunately, commercial fishermen in those areas were familiar with shad-tagging programs because of previous studies that have been conducted at various places along the coast. This undoubtedly helped in the return of tags, but it is probable that returns were not as good in the outside areas as in the areas canvassed. However, since returns from areas outside the Hudson and Connecticut Rivers were relatively few, any error caused by unrecovered tags would be minor and hence would not significantly affect the results obtained in this study.

A total of 1,183 tags was returned during the 1956 fishing season: 108 were returned by mail and 1,075 were collected by biologists in the field. In addition to the 1,183 tags actually returned, 15 were reported lost or misplaced. No correction was made for lost or misplaced tags since they were few in number and the location at which they were affixed could not be determined.

A number of types of fishing gear were instrumental in effecting the recovery of the tags. In the Hudson River, gill nets are used almost exclusively for catching shad. The nets are operated as stake gill nets south of Bear Mountain Bridge at Peekskill, N. Y., and as drift gill nets north of this area. Drift gill nets are the major gear fished in the Connecticut River; however, a few stake nets and haul seines are also fished. Pound nets accounted for the majority of recoveries outside the rivers. Of all tags returned, stake gill nets accounted for 702 (59.3 percent), drift gill nets 332 (28.1 percent), pound nets 122 (10.3 percent), sport fishermen 6 (0.5 percent), haul seines 3 (0.3 percent), and miscellaneous gears 18 (1.5 percent). Less than 1 percent of the tags were returned with insufficient data. These were included in the category of miscellaneous-gear recoveries.

Recaptures of tagged shad during 1956 began with the opening of the fishing season along the New Jersey coast, continued through the spawning migrations into the rivers, and ended in the latter part of September, several months after the spawned-out fish had returned to the sea. Fish tagged at the three tagging sites were recaptured along the Atlantic coast from Chesapeake Bay to the Gulf of St. Lawrence, with the majority being taken in the Hudson and Connecticut Rivers. Of the recaptures, 951 were made in the Hudson River, 91 in the Connecticut River, 13 in Delaware Bay, 12 in Chesapeake Bay and its tributaries, 5 in Canadian waters, 6 off the New England coast, 1 off the New Jersey coast, and 104 in the Sandy Hook, Raritan, and Lower New York Bay areas (table 2). In this paper the latter area will henceforth be termed the "New York Bay area."

During the tagging study, tagged fish were available to all New Jersey and New York coastal pound nets. Eleven tagged fish were recaptured by pound nets in the Beach Haven and Point Pleasant areas and these were subsequently released. Pound-net operators in the New York Bay area kept recaptured tagged fish and claimed the tag reward. During the 1956 season (table 2), 104 tagged shad were recaptured in the New York Bay area from all tagging locations. To determine the percentage of the New Jersey–New York pound-net catch native to the Hudson and Connecticut Rivers, the number of tagged shad from each tagging location recaptured in the New York Bay area was subtracted from the total tagged at each site. Therefore, the corrected number of shad tagged at each location free to enter

TABLE 2.—*Tag returns from shad tagged off the New Jersey-New York coasts during the spring of 1956*

Area of recovery	From tagging station at—						Total tags returned	
	Beach Haven, N. J.		Point Pleasant, N. J.		Staten Island, N. Y.			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Hudson River	247	81.2	317	79.1	387	81.0	951	80.4
Connecticut River	32	10.5	48	12.0	11	2.3	91	7.7
New York Bay	9	3.0	21	5.2	74	15.5	104	8.8
Other areas	16	5.3	15	3.7	6	1.2	37	3.1
Total	304		401		478		1,183	

TABLE 3.—*Tag returns from shad tagged off the New Jersey-New York coasts, excluding New York Bay, in 1956*

Area of recovery	From tagging station at—						Total tags returned	
	Beach Haven, N. J.		Point Pleasant, N. J.		Staten Island, N. Y.			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Hudson River	247	83.7	317	83.4	387	95.8	951	88.1
Connecticut River	32	10.8	48	12.6	11	2.7	91	8.4
Other areas	16	5.4	15	3.9	6	1.5	37	3.4
Total	295		380		404		1,079	

the Hudson and Connecticut Rivers was as follows: Beach Haven—934; Point Pleasant—941; and Staten Island—980, or a total of 2,855.

Table 3 shows the number and percentage of tags returned, excluding New York Bay recaptures, from shad tagged during the 1956 study. A total of 1,079 tags were returned from the 2,855 tagged fish, which represents a 37.8-percent return. Of the tags returned, 951 (88.1 percent) were returned from the Hudson River, 91 (8.4 percent) were returned from the Connecticut River, and 37 (3.4 percent) were returned from other areas.

During the 1957 shad season, 144 of the shad tagged on the New Jersey coast in 1956 were recovered by fishermen from North Carolina to Canada. Of these recoveries, 82.1 percent were from the Hudson River, 8.9 percent were from the Connecticut River, and 9.0 percent were from other areas. Thus, 1956 and 1957 recoveries compare favorably.

In previous limited tagging studies at Belford, N. J., in 1940, 1943, and 1945, E. H. Hollis [2] found that 85.2 percent of the tag recoveries were made in the Hudson River, 5.4 percent in the Connecticut River, and 9.4 percent in other areas. Similar tagging experiments in Sandy Hook Bay, N. J., in 1936, 1938, 1942, 1944, and 1946, indicated that 75.0 percent of the tagged fish were recaptured in the Hudson River, 6.6 percent in the Connecticut River, and 18.4 percent in other areas. (E. H. Hollis.[2]) The results obtained from these tagging experiments are similar to those obtained in our 1956 study.

The number of recoveries and areas of recovery of fish tagged at the three stations are shown in figures 1, 2, and 3. The migration pattern of the tagged fish was similar in that shad tagged at all three areas were recaptured from Chesapeake Bay to New England and Canada, with the majority of the recaptures being made in the Hudson River. All recaptures of tagged fish south of Rhode Island were made before or during spawning (before June 30). Eleven recoveries were made north of this area; four of these were taken in Canadian rivers before June 30, presumably before spawning. Seven spawned-out fish were recaptured in August and September (6 in United States waters and 1 in Canadian waters), during the 1956 fishing season. Three of these were recaptured by otter trawl in 45 to 60 fathoms of water in the Ipswich Bay area off the coast of Massachusetts, one off Nantucket Island, Mass., two off the coast of Maine, and one off the coast of Nova Scotia, Canada. It is probable that some of these recaptures were shad native to the Hudson or Connecticut Rivers, since shad native to rivers from Chesapeake Bay to Canada spend the summer and fall months in this general area (Talbot and Sykes, 1958).

To obtain a reliable estimate of the proportion of the New Jersey–New York pound-net shad catch that is native to the Hudson and Connecticut Rivers, the fishing rates in these rivers must be known. The calculated fishing rate in the Hudson River in 1956 was 44 percent and in the Connecticut River 24 percent.[2] Nine hundred fifty-one tagged shad were recaptured in the Hudson River where the fishing rate was 44 percent. By simple proportion it was estimated that 2,161 tagged shad entered the Hudson River. Similarly, 91 tagged shad were recaptured in the Connecticut River where the fishing rate was 24 percent; therefore, it was estimated that 379 tagged shad entered the Connecticut River. Thus, from these figures and the corrected total number of tagged shad it was calculated that the New Jersey–New York pound-net catch in 1956 was

[2] Unpublished data, U. S. Fishery Laboratory, Beaufort, N. C.

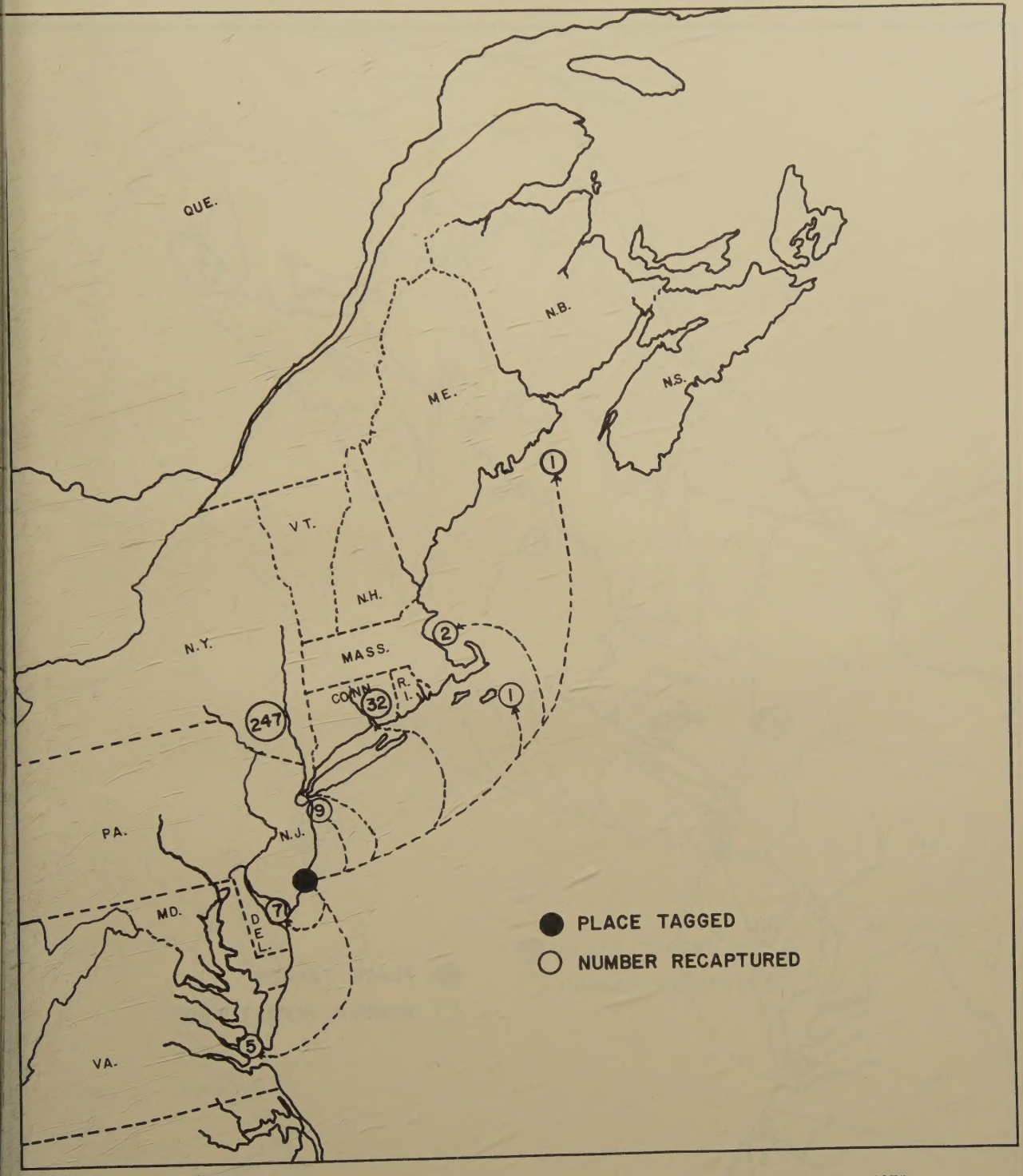

FIGURE 1.—Area and number of tag returns from shad tagged at Beach Haven, N. J., 1956.

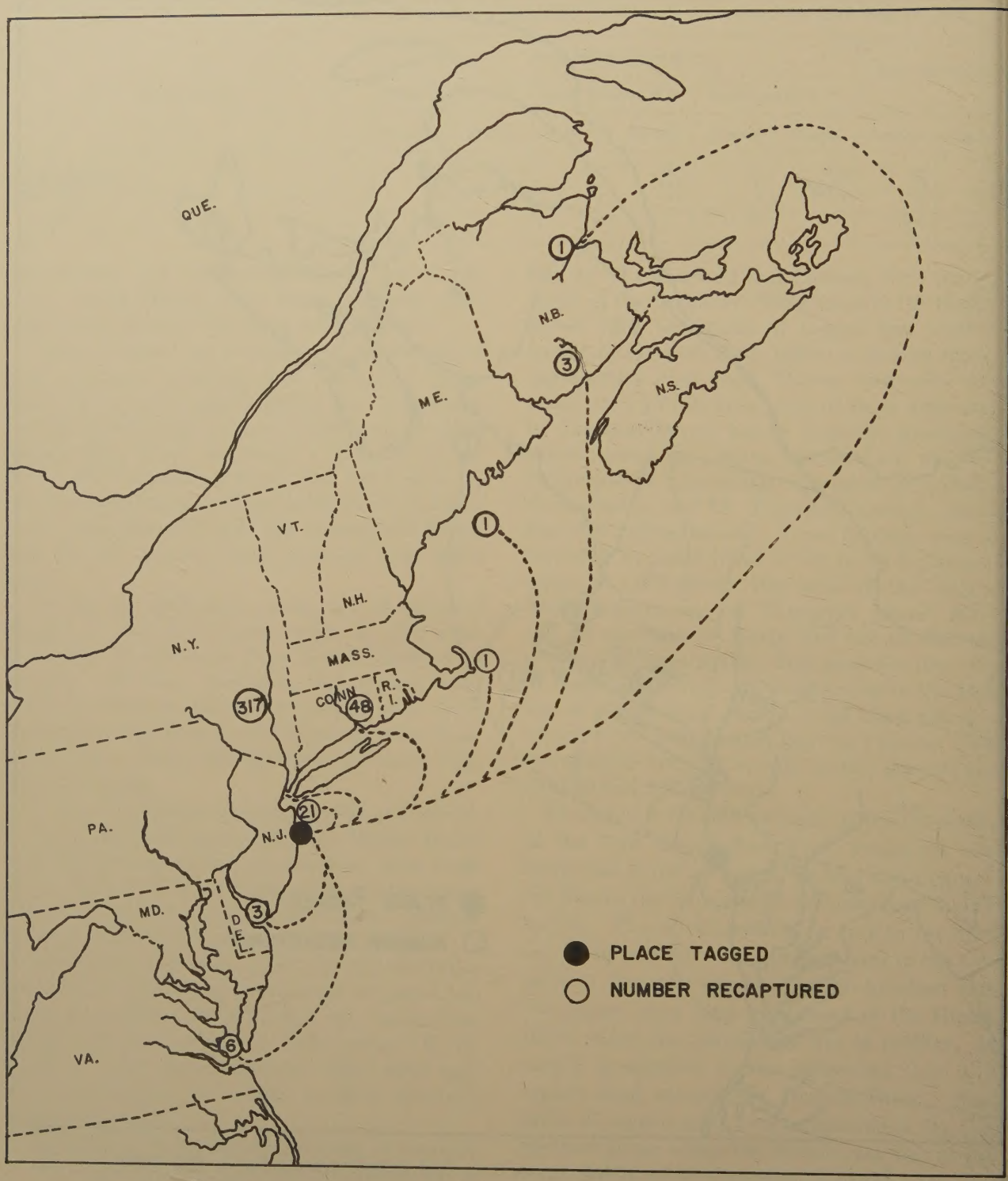

FIGURE 2.—Area and number of tag returns from shad tagged at Point Pleasant, N. J., 1956.

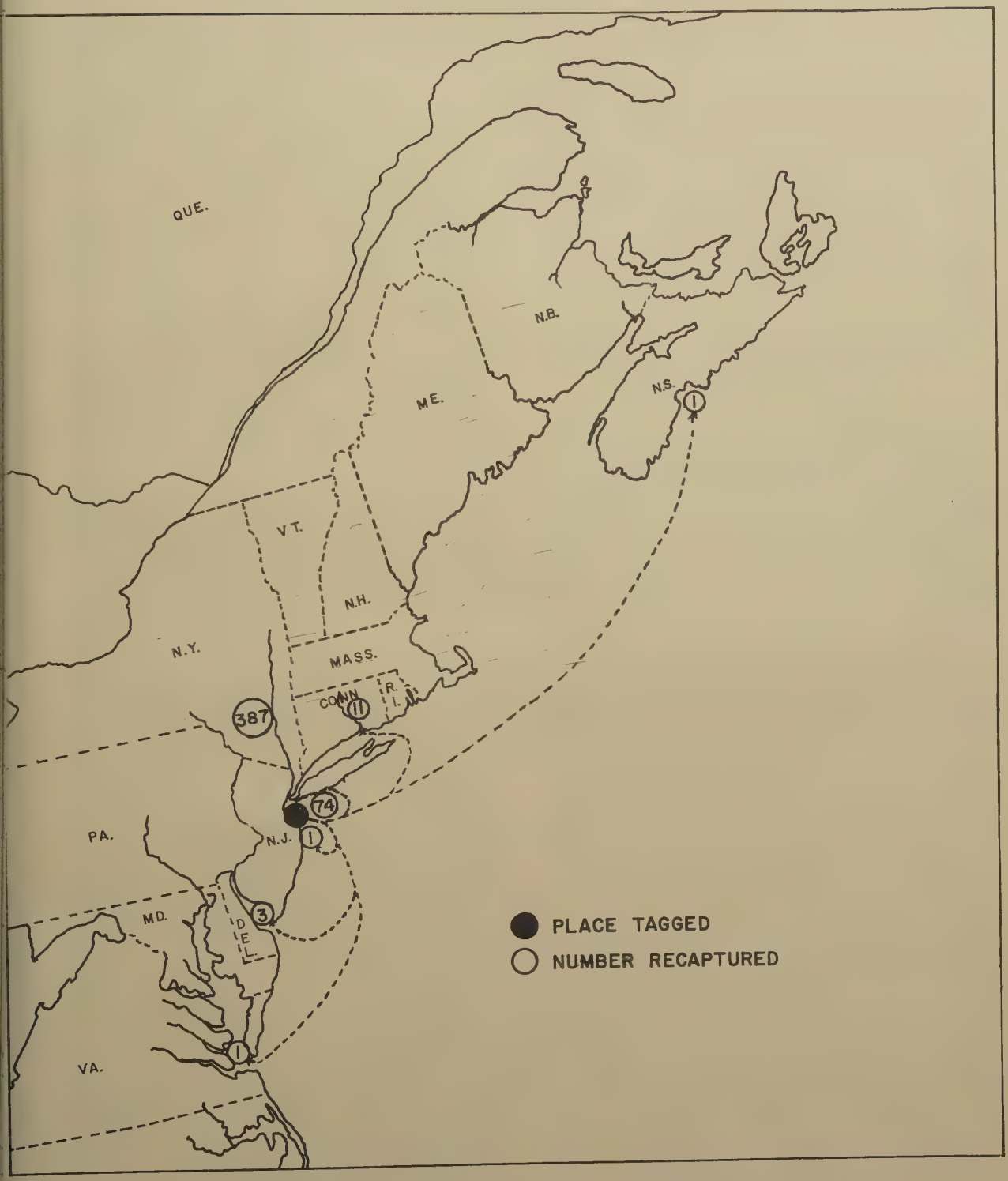

FIGURE 3.—Area and number of tag returns from shad tagged at Staten Island, N. Y., 1956.

composed of 76 percent Hudson River shad, 13 percent Connecticut River shad, and 11 percent shad from other areas.

The method outlined here assumes that the tagged fish are no more liable to capture than are the untagged. Previous studies in these rivers have shown that tagged shad are not significantly more vulnerable to capture than untagged shad, because of the size of the fish and the size of mesh fished. Analysis of the 1956 tagging results was not in disagreement with the earlier findings of other authors.

THE OCEAN POUND-NET FISHERY AND SHAD RUNS IN THE HUDSON AND CONNECTICUT RIVERS

The total populations of shad entering the Hudson and Connecticut Rivers as calculated from catch and effort data, and the predicted size of these populations based on escapements from the fishery in previous years, have been estimated for a number of years (Talbot 1954; Fredin 1954). These data are available for the Connecticut River from 1940 to 1956 [3] and for the Hudson River from 1921 to 1956,[3] and are shown in tables 4 and 5, together with the New Jersey–New York pound-net shad catch for most of these years. Also shown in the tables are the deviations between calculated and predicted shad runs in these rivers.

TABLE 4.—*Pound-net catch and calculated and predicted runs of shad, Connecticut River, 1940–56*

[In thousands of pounds; catch data from table 1. See text for source of Connecticut River data]

Year	New Jersey–New York catch	Population size [1]		
		Calculated	Predicted	Deviation [2]
1940	1,284	831	930	−99
1941		1,110	993	117
1942	2,864	1,008	1,113	−105
1943	1,765	1,068	1,029	39
1944	2,284	1,134	1,005	129
1945	2,008	927	1,059	−132
1946	796	1,098	960	138
1947	629	810	831	−21
1948	735	723	729	−6
1949	440	564	642	−78
1950	482	393	486	−93
1951	205	534	423	111
1952	844	747	465	282
1953	104	690	654	36
1954	252	573	657	−84
1955	400	519	669	−150
1956	351	669	702	−33

[1] Number of fish converted to pounds at ratio 1 fish=3.0 pounds.
[2] Calculated less predicted size of run.

[3] Data for years 1952 through 1956 are preliminary, U. S. Fishery Laboratory, Beaufort, N. C.

TABLE 5.—*Pound-net catch and calculated and predicte runs of shad, Hudson River, 1921–56*

[In thousands of pounds; catch data from table 1. See text for source o Hudson River data]

Year	New Jersey–New York catch	Population size		
		Calculated	Predicted	Deviation [1]
1921	43	349	73	27
1922		517	360	15
1923		446	505	−5
1924		334	524	−19
1925		440	305	13
1926	74	908	671	23
1927		884	1,380	−49
1928		634	1,067	−43
1929	21	500	858	−35
1930		442	1,252	−81
1931	69	1,006	974	3
1932	57	1,294	1,620	−32
1933	79	997	1,878	−88
1934		925	1,152	−22
1935	273	2,008	1,720	28
1936		3,796	3,292	50
1937	1,184	4,249	3,523	72
1938	701	3,253	3,578	−32
1939	590	4,437	2,996	1,44
1940	1,284	4,521	4,537	−1
1941		4,552	4,916	−36
1942	2,864	4,634	3,640	99
1943	1,765	4,484	4,522	−3
1944	2,284	5,473	4,533	94
1945	2,008	5,480	4,290	1,19
1946	796	4,167	5,664	−1,49
1947	629	2,588	3,230	−64
1948	735	3,225	2,509	71
1949	440	2,471	3,962	−1,22
1950	482	1,398	2,175	−77
1951	205	1,639	1,075	56
1952	844	2,321	2,435	−11
1953	104	2,200	3,048	−84
1954	252	2,752	2,671	8
1955	400	3,058	4,042	−98
1956	351	4,106	5,117	−1,01

[1] Calculated less predicted size of run.

Since a large proportion (76 percent) of the New Jersey–New York pound-net shad catch was composed of shad native to the Hudson River, a linear regression analysis was run between the calculated size of each year's Hudson River run and the shad catch in this area for the same years (table 5). The regression value obtained (r=0.81) was significant at the 1-percent level. Therefore, it can be inferred that the New Jersey–New York pound-net shad catch was dependent on the size of the Hudson River shad population. In other words, when the shad run bound for the Hudson River has been large the New Jersey–New York pound-net shad catch also has usually been large. Since a comparatively few Connecticut River shad were taken in this area (13 percent), fluctuations in the size of that population would not be expected to have any great influence on the New Jersey–New York pound-net shad landings.

The proportion of Hudson to Connecticut River shad taken by the ocean pound-net fishery in 195 was 6 to 1 (76 percent Hudson River to 13 percent Connecticut). This was approximately the rati

f the calculated size of the Hudson and Connecti-
it River shad populations in the same year (4,-
06,000 pounds to 669,000 pounds). Therefore,
pproximately the same percentage (6) of each
opulation was taken by the ocean pound-net fish-
ry in 1956.

The deviations that occur between calculated and
redicted size of shad runs represent changes in
he population of each river not accounted for by
scapements (Fredin 1954). Both Talbot (1954)
nd Fredin indicated that catches of Hudson and
Connecticut River shad made outside of the rivers
ay have an effect on the deviations between pre-
licted and calculated population size. Since all
ut a small percentage of the New Jersey–New
York pound-net shad catch is native to the Hud-
on and Connecticut Rivers, yearly fluctuations
n these catches could possibly cause the deviations
etween calculated and predicted populations en-
ering the two rivers.

To test this hypothesis, a linear regression anal-
ysis was calculated between the New Jersey–New
York pound-net catch and these deviations in
each river. For the Connecticut River (table 4)
the relationship was nonsignificant ($r=-0.05$).
For the Hudson River (table 5), a significant (5-
percent level) but positive relation was found be-
tween these factors ($r=0.47$). This indicates that,
in general, when the calculated Hudson River run
is larger than the predicted run (deviation would
have plus value) the New Jersey–New York
pound-net shad catch is large. Likewise, when the
calculated Hudson River run is less than the pre-
dicted run (deviation would have minus value)
the New Jersey–New York pound-net shad catch
is small. Therefore, the New Jersey–New York
pound-net shad catch had no apparent effect on
the deviations that occur between the calculated
and predicted sizes of Hudson or Connecticut
River shad runs.

In addition to the New York–New Jersey
pound-net catches, large ocean catches of shad
are made in the Gulf of Maine area by purse
seiners working out of New England ports dur-
ing the summer months. Some large catches of
"scrap" fish were reported by the U. S. Fish and
Wildlife Service (1956) to be 100-percent shad:

> Recent catches of large shad were reported by boats seining for menhaden. Two trips were landed that consisted of pure shad * * *. The two trips totaled about 120,000 pounds.

It was further reported that other landings at fish-meal plants consisted of a mixture of shad and herring. Undoubtedly, some of these fish were Hudson and Connecticut River shad, since after spawning adult shad native to rivers from Chesapeake Bay to Connecticut migrate northward and spend the summer and fall months in the Gulf of Maine (Talbot and Sykes, 1958). This extraneous fishing mortality may have an important influence on the deviations that occur between the calculated and the predicted sizes of Hudson and Connecticut River shad runs.

SUMMARY AND CONCLUSIONS

During the 1956 shad fishing season, 2,855 shad were tagged from pound nets located off the coasts of New Jersey and New York to determine the population composition or origin of the shad taken in these waters. Of the total number of fish tagged, 951 shad were recaptured in the Hudson River and 91 were recaptured in the Connecticut River. In 1956, the estimated fishing rate in the Hudson River was 44 percent and in the Connecticut River 24 percent. Based on the number of shad recaptured and the fishing rates in each river it was estimated that the New Jersey–New York pound-net shad catch in 1956 was composed of 76 percent Hudson River shad and 13 percent Connecticut River shad.

The total population of shad entering the Hudson and Connecticut Rivers calculated from catch and effort data and the predicted population size of shad entering the rivers based on escapements from the fishery in previous years have been computed for a number of years. A linear regression analysis calculated between the size of the Hudson River shad run and the New Jersey–New York pound-net shad catch indicates that the pound-net catch is dependent upon the size of the Hudson River shad population ($r=0.81$). Fluctuations in the size of the Connecticut River shad population would not be expected to have any great influence on the pound-net landings, since only 13 percent of the landings are composed of shad native to this river.

Since all but a small percentage of the New Jersey–New York pound-net shad catch is native

to the Hudson and Connecticut Rivers, yearly fluctuations in these catches could have some influence on the deviation that occur between calculated and predicted sizes of the runs entering each river. Linear regression analysis showed a significant but positive relation between the New Jersey–New York pound-net shad catch and the deviations in the Hudson River. In other words, when the calculated population size was larger than expected the pound-net shad catch was also high. When the calculated population size was smaller than expected, the pound-net catch was low. For the Connecticut River, the relationship was nonsignificant. Therefore, the New Jersey–New York pound-net shad catch has no apparent effect on the deviations that occur between the calculated and the predicted size of Hudson or Connecticut River shad runs.

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